1001ENG

Engineering Practice And Sustainability

Power Supply Workshop Manual

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Introduction

As part of the final assessment for 1001ENG – Engineering Practice and Sustainability, students enrolled in the Electronic and Computer Engineering and Software Engineering disciplines will complete the power supply (PSU) project, during which they will construct a fully-functional 20V power supply.

At the beginning of the project, each student is assigned into a group of 5 and is allocated a management role in which they are solely responsible for. The list of groups is posted on the subject website, and it is the responsibility of each student to find out which group they are in prior to the first lab session. It would be a good idea to contact the other members of your group at this time.

When acting as a manager, the person will be required to check laboratory times for their section of the project, and ensure that all members of their team accomplish the tasks required of them. They may also be required to take instruction courses and then to instruct their fellow group members in order to follow certain safety precautions or techniques. Each manager will also need to complete a report at the completion of the project detailing the tasks undertaken during the period of management, the performance of their group as both individuals and as a team, and any problems encountered. Each manager should thoroughly familiarise themselves with the relevant section of this manual, as well as reading through each of the other management sections.

This manual will supply all the necessary information required to complete the project, including assessment items and the reports which are required to be submitted.

Safety Considerations

This project will be completed entirely within the confines of the electronics laboratories and the metal workshop. As such, there are a number of safety requirements which must be adhered to at all times.

1. Appropriate clothing must be worn at all times. This includes **enclosed footwear**, ie no thongs or sandals. Rubber soled shoes are highly desirable.
2. Individuals should not work alone at any time. The relevant manager, the general manager, or a demonstrator should be present whenever work is being completed, including work done in the metal workshop.
3. No bags in the laboratories. These present a tripping hazard, and should be left outside in the racks provided.
4. No food or drink, **including water**, is permitted in the labs. Water and electricity do not mix.
5. All activities must be conducted in a safe manner, as instructed by the demonstrator or section manager. No shortcuts should be taken!

Equipment Required

The completion of the power supply project will require a number of items. All of these items are available from either the Science Store (in N34 building) or directly from the course convener and/or demonstrator. The list below shows all such items and their approximate cost.

PSU Mechanical Kit	$40
PSU Electrical Kit	$15
Toolkit	$???
Sheet Metal	provided

The toolkit is required for the first lab, and should have already been purchased for other laboratories. If students are already in possession of the tools in this kit, they can bring these in lieu of purchasing the kit. There are *very few* available spare tools in the labs, so it is important that each student has their own. The PSU electrical kit is required for the **assembly** portion of the project, which is usually held around week 6 of the semester. The mechanical kit is required during the **construction** phase, which commences around week 9-10. The managers for each of these phases must ensure that every member of their group has the correct equipment available ***before*** the lab session in order to avoid delays.

Group Communication

Email contacts between members will be important, as is learning to check your email on a regular basis. The General Manager, in particular, will be required to maintain regular contact with all managers to ensure that each member of the group is on track to complete their supply on time, and to report any possible problems to their demonstrator or convenor.

Assessment Outline

The power supply project is worth 25% of the total grade for the course, broken up in the following manner:

Attendance at all required workshops	5%
Individual management report	5%
Safety inspection of completed PSU	5%
Final report (group and individual)	10%

In addition, penalties will be levied against groups/individuals for various infringements committed during the course of the project. The following list gives examples of some such penalties; however it is by no means complete.

Leaving the lab/workshop in an untidy state	2% / occurrence (group)
Turning on supply before being checked	**25% (individual)**
Loss of sheet metal/components	1% / item replaced (individual)
Unsafe behaviour in lab	min 2% / occurrence (individual)
Inappropriate clothing/footwear	1% / occurrence (individual)
Unprofessional/inappropriate behaviour	1% / occurrence (individual)
Not following correct instructions	1% (individual, manager)
Late submission of reports	1% / day (group)

Important Milestones

There are a number of important milestones throughout the course of the project. It is important that these deadlines are met by all students, as failure to do so may result in significant delays or complete failure to complete the project. More details on each

such deadline are given in the various managers' sections below, and the following table gives a brief summary.

1. Case construction **must** be completed by the date of the first construction lab. For construction managers, this means the case must be completed one week earlier, as you are required to attend a construction managers meeting at this time. Depending on the timing of the Easter vacation, this may mean you have only a single week in which to complete all metalwork, so it is crucial that the Workshop Manager organise this part of the project well.
2. All construction must be completed in time for the electrical safety tests to be conducted. **NO** testing can be completed after this date, and without testing you **cannot** complete your project. The date of testing varies from year to year, however will generally take place 2-4 days prior to the 'faulty unit correction' workshop, around week 11.
3. The final report, including all managers' reports and PSU specification is due on the Friday of week 13. These reports are to be placed in the convenor's mailbox (Level 0, Technology building) on or before this date.

Project Timeline

An approximate timeline for the project is set out below. This is likely to change from year to year, depending on the timing of the Easter vacation and other public holidays, and the number of students enrolled in the course.

Week 5:	Assembly workshop (AM only)
Week 6:	Mechanical workshop lecture
	Assembly workshop 1 (all members)
Week 7:	Assembly workshop 2 (all members)
	Metalwork training session (WM only)
Week 8:	Completion of metalwork (all members)
	Construction workshop (CM only)
Week 9:	Construction workshop 1 (all members)
Week 10:	Construction workshop 2 (all members)
	QA and Specification workshop (QAM only)
Week 11:	Electrical safety tests conducted
	Faulty unit repair workshop (all members)
Week 12:	QA and Specification workshop (all members)
Week 13:	Reports due

From this schedule you will note that on some weeks you may be scheduled for more than one activity, depending on your role within the group. These managers workshops will be held at a separate time, and attendance is compulsory for the particular manager involved.

Electrical Safety Inspections

As part of the electrical safety specifications, it is necessary to carry out an electrical safety test on all the power supplies built. The construction managers must ensure that their group's powers supplies are ready for this test and left in the laboratory by the specified date. The electrical safety test will be conducted in week 11 of the semester

by qualified technicians. During this time all the power supplies from each group will be judged on construction, performance and presentation. The group will be allocated an overall grade which will contribute to 5% of the final grade for each student.

A pass/fail list will be put up on the course webpage on completion of this testing. The quality assurance manager must check this list and inform any members of their group whose units failed so they can be fixed in week 11 prior to the QA lab. The QA manager is responsible for ensuring that units are returned to their owners and failed units are repaired during this week and ready for the QA and Specification lab in week 12.

Final Report

This report is due at 5.00 pm on Friday in week 13. Late documents will not be accepted. It is worth 10% of your final grade for the subject, 5% is based on the individuals contribution and 5% is an overall group mark. The document is to be a maximum of 10 pages, with each manager's report added to the end as appendices.

The report is to be written by the group with each member writing sections. Each section must acknowledge the author/s (the person/people who have written the article). The editor/s (the person/people who have collated and proof read the documents, selected the formatting and have been involved in the finalisation of the document) should also be acknowledged. The general manager of each group is responsible for delivery of the finalised document.

Do not acknowledge a student if they have not contributed.

The report should be written like a user manual, describing everything that you would expect a user would like to know about the device. It may be useful to obtain an existing power supply manual for ideas, although keep in mind the university's rules on plagiarism.

Each of the topics listed below should be covered in the report. A suggested workload distribution is also provided, however your group is free to disregard this and distribute the topics in whatever way you see fit.

Cover Page:
This should be attached to the front of the report and contain the following information: title of the report, the names, student numbers and roles of each group member, the group number, the subject name and code, and the convenor's name.

Section 1: Introduction (Author 1)
This section should provide a verbal description of the unit with supporting diagrams, and safety precautions to be used when operating the device.

Section 2: User's Guide (Author 2)
This section gives a detailed explanation of the correct operation of the unit, along with a troubleshooting section to assist if the unit is not working properly.

Section 3: Testing Procedure (Author 3)

This section provides an explanation of the tests performed during the specification phase of the project. As this is an important component of the document and must be handled well, this author should only be given one topic to write. They also need to work closely with authors 4 and 5 and take detailed notes of all the testing performed in the Specifications and Testing Laboratory

Section 4: Specifications (Authors 4 & 5)
Specifications, with supporting test results of the system response (performed in the Laboratory and discussed as well as represented graphically) are given in this section. This is another important component of the document, and it is a good idea to have two students working on this section will ensure that the correct information is presented.

It is suggested that authors 1 and 2 should do the editing as they have the lightest load, but this is not compulsory. The editor/s must be acknowledged and will be marked accordingly.

Appendices: Managers' Reports and Test Data (all members)
The final section of the report should include manager's reports from each member of the group, and the raw data obtained during PSU testing.

The management report will contribute towards the 5% individual component of your assessment, and will also be used as a guide towards the performance of both the group as a whole and individuals within the group. Each report should be a **maximum of 2 pages** in length, although 1 page is the expected length in most cases. Each student shall report on issues related to their management area by addressing each checkpoint required in their module. You may discuss how you dealt with communications, bookings, conflict and/or any other organisational matters that either helped or hindered your management. Your checklist and a copy of the minutes from any meetings conducted should be included in the report; however these do not count towards the 2 page maximum.

The raw test data is included for completeness only, and its presentation is of no consequence. You may include handwritten data if necessary.

Report Guidelines
Correct referencing will be expected if used. Incorrect referencing may result in a grade of ZERO for this component. Plagiarism will result in a fail in the subject and will be reported to the Head of School where it will remain on the student's university record, as per the school's official policy.

General Manager Instructions

The general manager oversees all aspects of the project's development, including project completions, design of overall scheduling to ensure completions are met, and input in the design of testing and specifications. They are in charge of collating all paper work required at each deliverable, presentation and design, booking group meetings if required for their managers, confirmation of all laboratory bookings, email contacts, collecting minutes from managers, and reporting to the convenor.

The general manager should design a schedule to take the group through all the processes required and allow each person to meet their checkpoints. If the general manager notices any member of the group to be falling behind in their work, it is their responsibility to contact the person and get them back on track without actually causing any delay to be recorded.

You can access all the pages available to your group and take the place of any other manager if for any reason they are not available. We do not expect you to carry out your managers' work, however, and if this occurs we would like you to report it to your group supervisor.

Minutes must be taken at all group meetings. These record the date of the meeting, who took the minutes and those in attendance, and it provides a summary of what was discussed, what decisions were made, what action is to be taken and who is responsible for that action. The minutes should be put in a word document and included as an appendix in the Power Supply Report. Each manager is to take the minutes for their section and deliver them to you. When a meeting is called to discuss the overall operation or planning of the group then you should take the minutes.

General Managers are to complete a Management Report and deliver it to the convenor's mailbox by 5.00pm Friday at the end of week 13.

The importance of the specifications and testing session requires each member to actively contribute to the design of the measurement methods required for that session.

As a team member you are expected to support your group members throughout the Power Supply Project and as such you will be graded accordingly. See project performance under assessment for more information.

We have provided a Checklist to help guide you through your requirements and assist you in guiding your group members through theirs. Items on the checklist must be marked off as they are accomplished. Your checklist is to be provided as an appendix to your manager's report.

Unlike the other members of your group, you do not have a compulsory class to undertake. If you need assistance at anytime during the project, please do not hesitate to contact your convenor via email.

Checklist for General Manager

Conduct first group meeting before week 7 to clarify emails and contact numbers of group members.	Yes	No
Completed schedule by week 7	Yes	No
Confirm Assembly Manager attends in week 5	Yes	No
PCB population completed by end of week 8	Yes	No
Workshop requirements completed by end of week 8	Yes	No
Received minutes from Assembly Manager in week 9	Yes	No
Received minutes from Workshop Manager in week 9	Yes	No
Construction completed by end of week 10	Yes	No
Confirm delivery of power supplies is organised in week 10	Yes	No
Received minutes from Construction Manager in week 11	Yes	No
Confirmed electrical pass tags on all units before Specs. and Testing lab.	Yes	No
Contribution to the design of the specifications and testing methods	Yes	No
Specification and testing completed by the end of week 12	Yes	No
Complete and deliver a Management Report to convenor at the end of week 13.	Yes	No
Provide minutes from meetings conducted and include all as an appendix in Power Supply Report for week 13	Yes	No
Write your article/s allocated to you for the power supply report due in week 13	Yes	No
Collated and edited Power supply report, including schedule as an appendix and confirmed authors/editors listed.	Yes	No
Delivery Power Supply report by 5.00 Friday week 13.	Yes	No

Assembly Manager Instructions

As the assembly manager you are responsible for getting your group members through the assembly of their Printed Circuit Boards. To help you achieve this goal we provide an instruction class just to assembly managers on Friday week 5, 13:00 in N44 –1.05/-1.06. Here we take you through the population of your own board and highlight areas of importance that you must ensure your own group members follow. You will have time to complete your board during this workshop and hence have time to ensure that all your group members accurately populate their boards. You must ensure you have your Power supply kit and tool kit purchased for week 5.

Pre session
The day before the session, remind your team members to bring their PSU kits and their tool kits. Take your completed board to the session to make comparison easier.

During Session
Give your team safety instructions regarding soldering iron safety and position of first aid cabinet.

Check that soldering irons are on and wet the sponges.

Ensure all members have kits and have members ticked off on roll.

Give instructions on correct soldering technique and start team members on resistor installation. Ensure that you check each person's placement and soldering and correct if necessary before moving on.

Move onto capacitors, ensuring that the polarity of these is correct before soldering, then diodes, check the polarity again, follow these with regulators again checking correct placement and that these are pushed fully down.

Check that all boards have been completed correctly, remember it is your responsibility and an incorrect placement may cause permanent damage to a circuit and or injury.

Solder the long wires into the PCB. Make sure they are long enough to run neatly in a form to their destination. Total number of wires is 14; see wiring diagram if you need help. There are 2 sets of 3 holes for the pot connections but only 2 holes are required. You will notice that 2 of the holes are shorted together; you only need to use one of these in each set.

Ensure your group members clean their work area and sign out with your demonstrator within the 4 hour lab session.

Assembly Manager's Checklist

Attended compulsory assembly managers class	Yes	No
Organise a meeting with group members to discuss availability for Assembly Lab	Yes	No
Ensure students have paid for and bring their components required for Laboratory	Yes	No
Instruct group members on assembly required	Yes	No
Laboratory was left clean and tidy	Yes	No
Book a second Laboratory time slot, if required	Yes	No
Assembly Lab completed by the end of week 8	Yes	No
Supply minutes from meetings conducted to General Manager in week 9	Yes	No
Complete and deliver a Management Report to convenor at the end of week 10	Yes	No
Contribution to the design of the specifications and testing methods	Yes	No
Write your article/s allocated to you for the power supply report due in week 13	Yes	No

Workshop Manager Instructions

As the workshop manager you are responsible for ensuring that the metal work required for the power supplies is completed and the supplies are ready for the construction laboratory in week 9. You will be given a lecture on layout (bring pencils, metal sheet, rubber and a good ruler) and a workshop in N44 –1.18 on Friday of week 7 at 1pm.

You then need to direct your fellow group members through their workshop. In order to achieve this objective there are a number of activities that you must accomplish.

1. Book your lab session with the convenor. Times available are 2 hour sessions 9.00, 11.00, 13.00, 15.00 Monday to Friday of week 8, in N44 –1.18. These are available on a first come first served basis, so it is important that you book early. It is critical that *all* group members attend this session as it will be difficult to book a second session.

2. Ensure all group members have paid and collected their packs from the Science Store (Science 2 -1.02). Collect the five pieces of metal from Andrew in N44 1.22 and distribute to your group members, keeping one for yourself.

3. After instructing your group members on layout, ask your members to mark out their metal and have it completed prior to coming to the metal workshop (remember measure twice cut once). They each need to bring their metal, two pots (variable resistors) and the fuse holder. A sharp pencil is also required (mistakes can be erased). One side of metal has a protective plastic, keep that for the outside of the box and mark on the inside of the box. Names printed on plastic in felt pen.

4. On arrival at the workshop (key with school secretary), you need to sign your group members in on the attendance sheet, check that all tools are present on the shadow board, in the die rack and the following tools are present on the shelf. 4 x files, 3 x Automatic (self impacting) centre punches, 1 x scriber, 2 x Allen keys (for hole punch). List any missing tools on the attendance sheet and fill out an incident report stating the tools missing and deliver to Yvette's mailbox. TBN level 0

5. Instruct your members regarding safety in the workshop;
    - Only one person is to use the folder/guillotine at a time.
    - Only one person is to use the hole punch at a time.
    - ***Only* the metalwork manager is to change the punch and dies.**
    - No Food or drink allowed

6. Trim pot shafts. (rotate the team members through, each student should have two pots to trim).
    - Place measure slide into vice (on rear jaw),
    - Place waste end into the vice with the end of the shaft at the scored line on measure slide, (flat on shaft against front jaw) the outside of the vice is where you cut. This will allow you to cut 15mm off the shaft from the waste end using a hacksaw.
    - Remember a hacksaw only cuts in the forward direction, not when you're pulling back

7. Get each person to cut out their metal sheet placing cut A first then B, C, D etc as recommended on the "Guillotine in order of letters" sheet. Place any waste metal in the bin.

8. Cut out notches in the Flanges for the corners (flanges are the short sides that provide a folded edge).

   Yellow tin snips – cut a straight edge
   Red tin snips – cut to the left with the waste on the right
   Green tin snips – cut to the right with the waste on the left

   You can use the yellow snips or the guillotine to cut the straight corners.

   For the inside corners you should have the notch marked in a V shape with a 90 angle inside. You need to drill a hole first before you can cut the V shape out. Use centre punch to mark hole position, which should be slightly inside the 90 corner not exactly on the corner. Place the metal sheet on the block of wood provided and using the battery drill provided, drill the hole.

   When cutting the V shape, line the end of the snips to the hole that you've drilled then cut from outside inward, this stops you from going past the hole and repeat on the other side of the hole. If the cutting bends the metal a little you can use the hammer to dress it out by placing the metal over the flat part of the vice at the back or block of wood and dress it (hit it) gently back into shape.

9. The holes to be punched out will need to be centre punched first so you can locate the correct position of the hole with the hole punch. Using the self impacting (automatic) centre punch, place your metal sheet on the block of wood, place the centre punch on the mark and push down on the punch.

10. **Using the hole punch.** You are in charge of selecting and placing the correct punch and die in the punch, start with the largest size first. Select the correct size for both the punch and die. If you don't have the same size for both you could shatter both of them and they are expensive to replace. You could also wreck the sheet metal you're punching. Once the punch and die are selected you need to place them in the punch.

    The stripper hangs from the top of the punch and helps to separate the cut hole from the metal sheet when punching is completed. This piece, when unscrewed, can swing up out of the way when you're putting in the punch and die. Swing it up over the top and screw it so it stays up.

    The punch fits in the piece above the die. Again there is a screw to undo to get it in and fix it in place. This screw needs the Allen key provided.

    The die (metal donut piece) sits in the bottom of the hole punch, machined side up.You need to unscrew the pin which will hold it in place to sit it in, then screw it back up when in. If fitted properly the piece should fit so the top has a flat surface. To remove knock it out from the underneath.

Once your punch and dies are in place swing the stripper back down, centre it, and screw it in place. If you don't the metal will become stuck on the punch and you'll have to wreck it to get it off.

Punching the holes is simply a matter of feeling the centre punch mark with the centre
locating point and then lowering the punch through the metal. Get all the holes of one size done first then change the punch and die for each consecutive hole. Oil the punch before starting punching. Regularly lubricate the 3mm punch to prevent the build-up of metal on the punch.

(Hint- to prevent punching holes with the wrong size, mark only the holes to be punched with the current size with a highlighter pen.)

There are some holes that need to be bigger than the bit size provided, to make these holes the right size you use a reamer (to enlarge it) and then a deburrer (to smooth it).

The holes needing to be enlarged are;
1 x 10/12(13): use 10 punch then use the reamer to enlarge it by twisting the reamer back and forth in the hole. Use the fuse holder to check if the hole is big enough. Finish the hole with the deburrer placing it in the hole and turning back and forth until the hole is smooth.
1 x 5.5/6: use the 5.5 punch and then enlarge as above, use the pot shaft to measure if the hole is big enough (not including the thread)
2 x 5.5/7: as above then use the pot shaft including the thread to measure if the holes are big enough.

Finish all the hole punching and notch cutting before folding.

11. Folding should be done individually. Students need to make sure their score line is correctly lined up with the folder before applying any pressure. A slight inaccuracy may result in the box not fitting correctly. You also need to make sure that your group members don't over fold as they can cut the metal if they go to far. Tell them they can watch the folding from the side and stop at 90 degrees. Do the folds as indicated on the folding sheet starting at A and moving through to F. If the folds are not done in order you will not be able to complete the folding. ***The top should not be folded until the body has been folded, this allows you to check the bottom of the box with the fold lines of the lid and adjust the folds to fit box if necessary.*** The heat sink is in two pieces, the large piece has a fold at each end of 45 degrees and the smaller piece has a fold of 90 degrees at each end.

12. Fit boxes together so the final drilling of the screw holes in box, already punched in lid, can be lined up correctly and completed. Don't forget the final hole for the heat sink.

13. Organise all members to help clean workshop and replace all tools. All metal shavings and scrap pieces should be placed in the bin.

14. Confirm that all tools are present and sign your group out. Return key to school secretary or give to metal manager of next group coming in if they are present.

Incident report

There is an incident report available in the workshop if you need to report anything to your supervisor. This should be filled out if any tools are missing, if any accidents happen, any equipment is not working correctly or if you had any problems with any of your group member. Deliver the incident report to your supervisor's mailbox in TBN level 0.

There is a FIRST AID KIT available in the hallway of –1 level technology building if it is required.

Construction Managers Instructions

This is the most difficult section of the power supply development; this means you have a very important role to play within your group. There is an extremely important safety aspect which must be adhered to, ie you must ensure that no one in your group connects their power supply to the 240V supply until it has passed its' safety check (indicated by a pass on the sticker on the box) The safety check is performed by a qualified technician and demerits will be allocated for sections that fail. All units must be passed before the specifications and testing Laboratory. It is your job to ensure that the power supplies in your group are ready for the safety check with as few defects as possible.

To ensure you have time available to spend organising your team members we will guide you through your construction separately. The compulsory construction manager's class will be held on Friday week 8 at 13.00 in N44 –1.06. You need to bring your completed metal box and PCB as well as your tool kit and mechanical power supply kit. During this class we will highlight important items that you need to highlight to your group. Your group will need the full 4 hours to complete this lab and you will have to push them to get them through.

Pre Session

The Day before the booking remind the group to bring their toolkits and mechanical PSU kit, their completed PCB's and metal boxes. Read the construction instructions again to ensure you have all sections of the assembly thoroughly memorised, especially those concerned with electrical safety.

On the Day

Warn group that they MUST NOT connect the supply to 240V until it has been passed by the technician at the safety check. Students caught doing so (who are still alive) will be seriously penalised.

Explain to group the order of assembly.

Check that all PCB's are populated correctly and soldering is OK.

Lead members through construction process (see below).

Act as a double checker that wiring is correct.

Get Lab Demonstrator to triple check 240V wiring.

Ensure all PSU's are clearly labelled with student's name and group number.

Arrange with Quality assurance manger and lab demonstrator for storage of PSU until safety check.

Construction Instructions

1. Check that the mounting holes for the regulators in the box have no burrs. Smooth if they do. (Use the deburrer in the metal workshop) This is **very**

important as burrs will eventually cut through the insulator between the regulators and the box, shorting the regulators to the box.

2. Remove the protective coat on your box and attach the rubber feet to the base of the box.

3. The following hardware should be fixed into the box: binding posts (Banana connectors) and the fuse holder. Refer to the power supply connections diagram on Maxwell for placement. The spring washers for the binding posts and the flat washer for the fuse all fit on the inside of the box. Once fixed, tin the connectors of the binding posts and the middle and upper connectors of the fuse holder. Insert the pot mount inside the box and place the pots into position, aligning the pot tabs with the smaller holes so the mount lays flat up against the box. The washers and nuts for the pots fit on the outside of the box and then the knobs fit on the end of the shaft. The cap on the knobs can be taken off with a knife and these can be rotated so the white line indicator points up when knob is fully turned to the left. Tin the middle and right connectors (looking into the box from front) of both pots. You may find this easier if you bend the tabs back about 90degrees.

4. Install the LED using the bezel and shorten the legs, **but** make sure the anode (positive leg) is left longer than the cathode (negative leg) for easy identification later.

5. Install the PCB using PCB standoffs and screw the regulators onto the case, including the two heat sink plates, with 3mm screws. The 337 and 317 regulators must be insulated from the box as the metal tag is not at ground. Follow the power supply connections diagram to install these correctly. The insulating bushes must be placed so they go into the hole in the regulators. The 7805 doesn't need to be insulated so a normal metal washer suffices. All the nuts go on the inside of the box.

6. All the wires should have been soldered on to the PCB. It is a good idea to write the colours of each wire, where it runs from and to, so you avoid connecting the wrong wires at the other end, see wiring diagram if you need help. Lay all the wires from the PCB neatly in the box and terminate all except the transformer connections. Try to keep all the wires parallel in the form (ie don't twist them). Placing ties (cable ties or wire twists) along the form at strategic points will help keep the form tidy. Each wire should be cut to its required length.

7. **240V cable connection.** Place the rubber grommet in the hole in the box. Feed the flex (cable) through the grommet and keep feeding so there is enough cable to reach the furthest point ie the grounding point (on wiring diagram). Don't forget the p clip holding the cable against the box will pull the cable down so include this in your measurement. Mark the cable after the p clip to indicate where the cable should be stripped. Pull the cable back out through the grommet so you can remove the sheath. To cut the sheath bend the cable tightly around your index finger so it forms a u turn over your finger. Using your other hand and steadying against the hand holding the cable place a nick

in the cable, (you only need to just touch it with the knife, DO NOT CUT BACK and FORTH). Rotate the cable and place another nick continuing to do so around the cable. You must be careful not to cut the internal insulation on the wires or you will need to start again. Bend the cable back and forth to break any connection left in the insulator and slide the insulator off the cable by pushing from the cut side out. Remove approximately 5mm of the inner insulator on the 3 internal wires (use cutters or knife) and tin the live and neutral wires (**not ground**). Feed the exposed cable back through the grommet continuing until the cable reaches the grounding point.

8. Install the power clip (p clip) holding the 240V cable, into the hole near the back of transformer using the supplied (see demonstrator) 3mm screw, washer and nut.

9. **Internal grounding of the 240V power cable.** This needs to be a physical connection with **no solder**. Use a grounding lug to terminate the earth wire. Crimp the exposed wire into the middle section of the lug with the 20-22 section of the crimping tool and use your pliers to crimp the insulation relief (the end of the lug over the insulated wire) see power supply connection diagram. 20-22 crimp must be squeezed very tightly to ensure connection.

10. Attach lug to hole near front of transformer using a star washer between the box and lug to ensure a good connection from ground to the box. Refer to power supply connection diagram for a picture.

11. You need 4 pieces of the smaller heat shrink so cut what you have to get 4 pieces. Feed a small piece of heat shrink (approx 10mm long) onto the Active (Brown) wire. Then feed a large piece of heat shrink onto the Active wire.

12. Solder the active wire of the 240V power cable onto the middle connector of the fuse holder. (Care should be taken so as not to melt the plastic) Let it cool then slide the small piece of heat shrink over this connection covering all the exposed metal and heat with a blow dryer to shrink it.
Show your demonstrator/construction manager before covering any connection with heat shrink.

13. Tin all the required connections on the transformer.

14. Install the transformer using two 3 mm screws, washer and nuts. The 240V terminals (primary side) should go on the side closest to the power cable entry.

15. Feed a small piece of heat shrink onto the neutral wire of the power cable and solder the wire to the connection on the transformer. (see wiring diagram) Let it cool then slide the heat shrink up so it covers any exposed metal and heat it to shrink it.

16. Cut a length of 240V wire (on reel in lab) to fit between the fuse holder and the other base connection on the transformer. Tin both ends. Solder one end to the top fuse connector. Let it cool then slide a small piece of heat shrink up over the exposed solder and heat to shrink it. Now feed this wire through the

large heat shrink on the active wire of the power cable. Slide the large heat shrink up over the whole fuse. It should cover the two connections and part of the fuse holder. See 240V connection diagram for help.
Check with your demonstrator before shrinking it to make sure your connections are ok.

17. Feed another small piece of heat shrink onto the wire connected to the top of the fuse holder and solder the free end to the base connection of the transformer. Let it cool then slide the heat shrink up over this connection and heat it.

18. Complete the final connections of the transformer to the PCB. These connections do not require heat shrink.

19. **Power Plug.** Slide the nut and plug cover onto the 240V power cable. Terminate the 240V cable in the plug following the instructions on the back of the packet. The inner insulator must not be nicked nor can it be clamped in the metal fasteners. No bare wires should be exposed in the plug. **Don't slide the plug cover over the plug until it has passed the safety inspection.**

20. Clean up your workstation and ensure your groups power supplies are neatly labelled and stored correctly.

Quality Assurance Manager Instructions

As the Quality Assurance manager you are responsible for ensuring your group's PSU devices are tested thoroughly to obtain the required specifications for the final document. In order to do this you must attend the compulsory specifications and Testing Class in week 10 on Friday at 14.00 in room N44 -1.06. Here you will be given instruction as to how the required measurements are to be achieved and introduced to equipment that you have not seen before. It is also your responsibility to check that all your groups power supplies pass the electronic workshop test and if not, that you advise the owner of the unit and arrange a time in the faulty units lab week 11 so the unit can be corrected. This information will be available on maxwell on Monday week 11.

Before the Day

1. Organise with your group a suitable timeslot for pre-session meeting, explain what will happen during the testing lab and organise a time for the post-testing session to collate the results.

2. Discuss with group the testing procedure and design the tests to be performed

3. Remind group to bring tools/power supplies

4. Check the maxwell site to see if any units from your team have failed the safety test. This will appear in week 11 sometime before the Friday lab. You must arrange for them to be fixed by their owners during the lab session of week 11. All other members should also attend this session to have their PSUs powered up by a demonstrator and checked for functionality.

On the Day

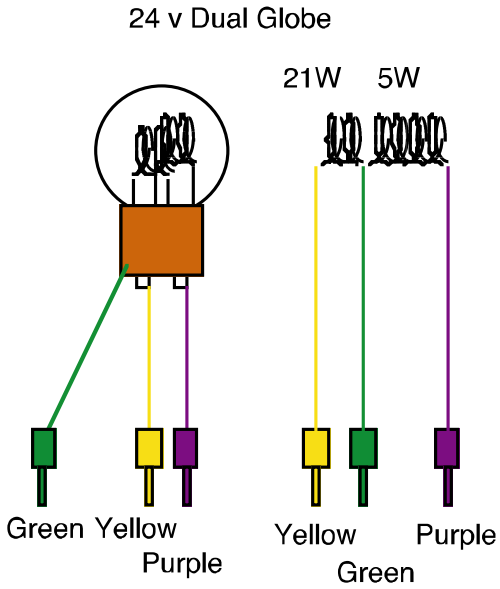
1. Test the supplies to see that all outputs work. Use a voltmeter to do this. Be careful at first turn on. If capacitors have been placed in backwards they could explode, so do not have your face or hands near the box when first powered up.

2. Fault find and repair if necessary. BE VERY CAREFUL AROUND THE 240V SECTION EVEN THOUGH IT IS INSULATED. DO NOT TRY TO MEASURE THE 240 VOLT SECTION. You may need to get assistance from your demonstrator.

3. Set up the tests and perform each test on each unit. You may break the group into teams to run different tests at the same time. As there are only 4 variacs, you will have to schedule this test with other groups.

4. Ensure that the final results are distributed to the members that are to write up those sections. Remind the team of the deadlines for the report and ensure all members know what they must write up, the format you have adopted, and where and when you will meet for the final collation and checking. This process may take a number of goes and you must do whatever is required to ensure the report is completed.

The Dummy Loads



The globes can be used as individual filaments (purple to green or yellow to green) or in series (yellow to purple) or a number of globes can be put in series or parallel. If you overload the supply the regulator will shutdown to protect itself. The power supply will probably only be capable of a maximum current of somewhere between 1 and 2 amps before the output voltage goes lower than your required specification. You should therefore concentrate your measurements in this working region.

The Quality Assurance Manager should finally ensure that the raw test data is supplied to the appropriate authors of the final report, so that they can complete the specification of the PSU.